

1           1.     A carbon nanotube device comprising:  
2                     a support structure including an aperture extending from a front  
3 surface to a back surface of the structure; and  
4                     at least one carbon nanotube extending across the aperture and  
5 accessible through the aperture from both the front surface and the  
6 back surface of the support structure.

1           2.     The device of claim 1 wherein the carbon nanotube comprises a  
2 single-walled carbon nanotube.

1           3.     The device of claim 1 wherein the carbon nanotube comprises a  
2 multi-walled carbon nanotube.

1           4.     The device of claim 1 wherein the carbon nanotube comprises a  
2 semiconducting carbon nanotube.

1           5.     The device of claim 1 wherein the carbon nanotube comprises a  
2 metallic carbon nanotube.

1           6.     The device of claim 1 wherein the at least one carbon nanotube  
2 comprises a plurality of carbon nanotubes.

1           7.     The device of claim 1 wherein the support structure comprises a  
2 substrate.

1           8.     The device of claim 7 wherein the support structure comprises a  
2 semiconducting substrate.

1           9.     The device of claim 1 wherein the support structure comprises a  
2     membrane.

1           10.    The device of claim 9 wherein the membrane comprises a silicon  
2     nitride membrane.

1           11.    The device of claim 9 wherein the membrane comprises a silicon  
2     dioxide membrane.

1           12.    The device of claim 1 wherein the support structure is aligned  
2     between a source of electrons and an electron detector for transmission  
3     electron microscopy of the carbon nanotube.

1           13.    The device of claim 1 further comprising at least one pair of  
2     electrically conducting contact pads disposed on the support structure and  
3     separated by the aperture, with each end of a carbon nanotube located at a  
4     contact pad.

1           14.    The device of claim 13 wherein each carbon nanotube end  
2     disposed on top of a contact pad.

1           15.    The device of claim 13 wherein the at least one pair of  
2     electrically conducting contact pads comprises a plurality of pairs of contact  
3     pads disposed at locations around the aperture.

1           16.    A method for fabricating a carbon nanotube device comprising:  
2                    providing a support structure;  
3                    forming at least one carbon nanotube catalyst region on a  
4     surface of the support structure;

5                   forming an aperture from a front surface to a back surface of the  
6                   support structure adjacent to the catalyst region; and  
7                   exposing the catalyst region to a hydrocarbon gas, synthesizing  
8                   across the aperture a carbon nanotube that is accessible from both the  
9                   front surface and the back surface of the support structure.

1                17.    The method of claim 16 wherein forming a carbon nanotube  
2                catalyst region comprises vapor depositing a catalyst material and  
3                lithographically patterning the deposited catalyst material to define the  
4                catalyst region.

1                18.    The method of claim 17 wherein vapor depositing a catalyst  
2                material comprises thermal evaporation of a catalyst material.

1                19.    The method of claim 18 wherein vapor depositing a catalyst  
2                material comprises thermal evaporation of Fe.

1                20.    The method of claim 16 wherein forming a carbon nanotube  
2                catalyst region comprises forming a catalyst region of less than about 2 nm in  
3                thickness.

1                21.    The method of claim 16 wherein the carbon nanotube catalyst  
2                region is formed to substantially about the aperture.

1                22.    The method of claim 16 wherein the at least one carbon  
2                nanotube catalyst region comprises at least one pair of carbon nanotube  
3                catalyst regions.

1           23.    The method of claim 16 wherein the support structure comprises  
2           a substrate.

1           24.    The method of claim 16 wherein the support structure comprises  
2           a membrane.

1           25.    The method of claim 16 further comprising forming an  
2           electrically conducting contact pad under the carbon nanotube catalyst region  
3           on the support structure surface.

1           26.    The method of claim 25 wherein forming an electrically  
2           conducting contact pad comprises depositing a layer of metal and etching the  
3           metal layer to form a contact pad prior to forming the carbon nanotube  
4           catalyst region on the contact pad.

1           27.    The method of claim 16 wherein the hydrocarbon gas to which  
2           the catalyst region is exposed comprises substantially only methane.

1           28.    The method of claim 27 wherein the methane gas is supplied at  
2           a flow rate of less than about 400 sccm.

1           29.    The method of claim 27 wherein the catalyst region exposure to  
2           methane is carried out at a temperature of less than about 1500 °C.

1           30.    The method of claim 16 wherein the catalyst region exposure to  
2           hydrocarbon gas further comprises applying an electric field across the  
3           aperture in a direction corresponding to a desired nanotube synthesis  
4           direction.